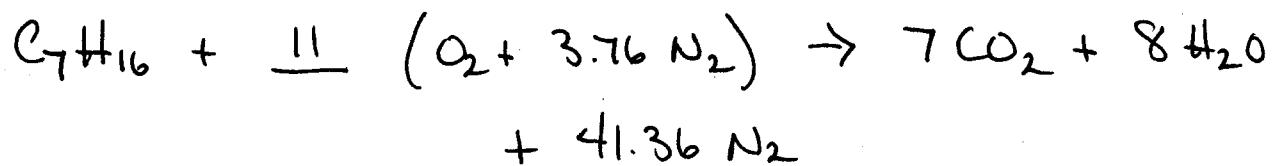


problem 14.43

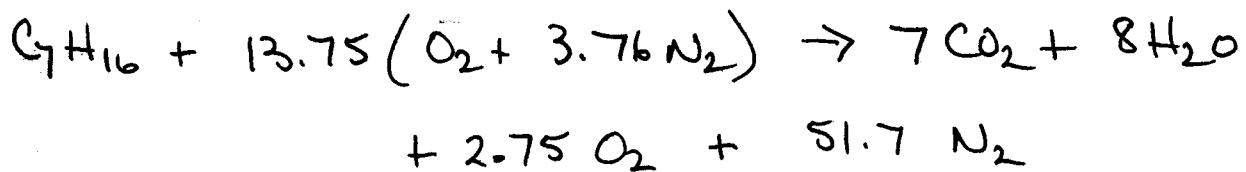
Combustion of heptane  $C_7H_{16}$  takes place at  $P_0, T_0$  [0.1 MPa, 25°C]

125% Theoretical Air - Products exit at 600K  
Find Q per kmol of heptane ( $\bar{q}$ )

Theoretical Combustion



Combustion w/ 125% Theoretical Air



$$Q = \sum n_e (\bar{h}_f^\circ + \Delta \bar{h})_e - \sum n_i (\bar{h}_f^\circ + \Delta \bar{h})_i$$

$$\begin{aligned} Q = & 7 (\bar{h}_f^\circ_{CO_2} + \Delta \bar{h}_{CO_2}) + 8 (\bar{h}_f^\circ_{H_2O} + \Delta \bar{h}_{H_2O}) \\ & + 2.75 (\bar{h}_f^\circ_{O_2} + \Delta \bar{h}_{O_2}) + 51.7 (\bar{h}_f^\circ_{N_2} + \Delta \bar{h}_{N_2}) \\ & - (\bar{h}_f^\circ_{C_7H_{16}} + \Delta \bar{h}_{C_7H_{16}}) - 13.75 (\bar{h}_f^\circ_{O_2} + \Delta \bar{h}_{O_2}) \\ & - 51.7 (\bar{h}_f^\circ_{N_2} + \Delta \bar{h}_{N_2}) \end{aligned}$$

Reactants enter at  $25^\circ\text{C} = 298\text{ K}$

$$\Delta \bar{h} = \bar{h} - \bar{h}_{298\text{ K}} = 0$$

Enthalpy of Formation of Elements

$$\bar{h}_f^\circ = 0$$

$$\bar{h}_f^\circ_{\text{N}_2} = 0 \quad \bar{h}_f^\circ_{\text{O}_2} = 0$$

Products	$\bar{h}_f^\circ$	$\bar{h}_{600\text{K}} - \bar{h}_{298\text{K}}$
$\text{CO}_2$	-393,522	12906
$\text{H}_2\text{O}$	-241,826	10499
$\text{O}_2$	—	9245
$\text{N}_2$	—	8894

$$\bar{h}_f^\circ_{\text{C}_7\text{H}_{16}} = -187,900$$

$$Q = -3,841,784 \frac{\text{kJ}}{\text{kg of C}_7\text{H}_{16}} \leftarrow \begin{array}{l} \text{assumed one} \\ \text{knot of fuel} \end{array}$$

$$M_{\text{C}_7\text{H}_{16}} = 7 \cdot (12) + 16 = 100$$

$$Q = -38,417.8 \frac{\text{kJ}}{\text{kg of C}_7\text{H}_{16}}$$